

ARE MOUNTAIN GOATS PARTICULARLY SENSITIVE TO ANTHROPOGENIC DISTURBANCE?

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Abstract: Numerous documents allege or suggest that mountain goats (*Oreamnos americanus*) are unusually sensitive to human-caused disturbances. Based on a review of available literature, starting with the first published mention of the subject about 25 years ago, this paper assembles what we know about the nature and significance of that presumed goat sensitivity for various kinds of disturbance. My assessment distinguishes between documentation and speculation in the description of effects, and shows how careless or over-zealous literature citation has often failed to make that distinction. I also provide some published evidence on the behaviour of mountain goats as related to the habitats they occupy, suggesting that some of what we interpret as serious reaction may actually be little more than part of the daily routine. Finally, I offer my thoughts on demographic consequences, certainly the most important disturbance-related topic for future consideration. The objective is not to disclaim the potential importance of disturbance factors in mountain goat management, but rather to encourage a) more forthright expression of what we actually know, and b) more research and monitoring on what we need to know.

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It's almost mantra. Goats are sensitive. Goats are sensitive. Goats are sensitive... Few papers on the species in the last two decades have failed to mention it, and I am regularly confronted with it in my deliberations as a consultant for industry in northern BC. My problem is that the mantra does not fully accord either with what I have read or with my own experience. Needing to resolve that, or at least confirm the validity of my discomfort, I decided it was time to do a thorough revisit of the literature and, having done that, I subsequently decided that there was no point in keeping the results, or my perspective, to myself. Hence, this paper.

This is not a comparative offering in the sense of assessing whether mountain goats (*Oreamnos americanus*) are more or less sensitive than other species. Although some reference to other species and to general principles as related to disturbance is also provided, the focus here is disturbance effects on goats. The primary purpose is to summarize what we actually know and to assess the transfer of knowledge on that subject.

PREMISES AND DEFINITIONS

“From a conservation perspective, human disturbance of wildlife is important only if it affects survival or fecundity and hence causes a population to decline” (Gill et al. 2001). With that point echoed in other documents (Shank 1979, Wilson and Shackleton 2001, National Research Council 2005, Goldstein et al. 2005), most researchers recognize that and, I think, aspire to take their studies to that level. Wilson and Shackleton (2001) clearly described three different levels of study applicable to their proposed research, as follows: “short-term acute behaviour (to determine whether...reactions suggest habituation or sensitization to helicopter disturbance)”, “medium-term chronic behaviour (to determine whether disturbance history leads to changes in movement behaviour, or to temporary and/or permanent range abandonment)”, and “long-term demographic consequences (to determine whether there are differences in key population parameters between tenure and non-tenure areas)”. They note that “for management purposes, short- or medium-term responses are a

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concern only to the extent that they lead to changes in the ability of goat populations to sustain themselves in areas where they are actively disturbed.” I use those three levels (short, medium, and long term, as described) in the remainder of this paper.

Whittaker and Knight (1998) recognized three categories of wildlife response to humans (attraction, avoidance, and habituation). The literature on mountain goats includes examples of all three. The most extreme examples of attraction are from national park situations, in which goats have reportedly sought out recreational campsites to exploit the mini-mineral lick potential of human urine deposits (Bansner 1976, Anunsen 1993). As will be evident in following pages, avoidance is the response that has most often been the focus for mountain goat disturbance studies to date.

Habituation, as defined by Whittaker and Knight (1998) is the “...waning of response to a repeated neutral stimulus” (i.e., learning to ignore it). It was documented experimentally for mountain goats by Penner (1988), but the best example may be the experience at the Walton mineral lick in Glacier National Park, Montana. In the mid-1970s, a new high speed highway was constructed within 50 m of the lick, with four nearby bridge and overpass structures to minimize direct road crossings by the animals accessing it. A viewing platform, providing public observation of the goats, was constructed about 60 m from the lick, with a parking lot nearby. The goats adapted to the disturbance involved, including daily passage of hundreds of vehicles on the highway, as they had to the presence of a smaller highway without crossing structures and with unregulated viewers previously (Singer and Doherty 1985a, Pedevillano and Wright 1987).

MOUNTAIN GOAT LITERATURE

The body of literature on the species is relatively small, facilitating intensive review. A check of references in the recently completed management plan for BC (Mountain Goat Management Team 2010), a very thorough document, suggests that my assessment is complete at least through that year. Note that I have not attempted to incorporate disturbance-related projects that are underway, but not yet completed.

Only 4 of 480 references listed in two bibliographic compilations for the period 1900-1978 (Foster 1977, 1979) are among the papers referenced here. From that, its absence in two major review papers (Rideout and Hoffman 1975, Wigal and Coggins 1982), and its position in a research priorities paper (a sub-topic under Priority No. 5, Eastman 1977), it is apparent that disturbance of mountain goats as a distinct issue and research subject had just started to emerge by the early 1980s. Up to that time, people who logged significant time observing goats portrayed a picture of a species that seemed to be particularly unwary, sometimes approachable to within a few metres (Brandborg 1955, Lentfer 1955, Holroyd 1967, Bansner 1976, Chadwick 1977, Thompson 1980).

The field studies that have directly and systematically recorded observations pertaining to the mountain goat disturbance issue, and therefore the apparent foundation for the “sensitive” label, are listed in Table 1. Most (6 of 8) were focused primarily on the responses of goats to helicopters. The two exceptions, both relating to noise and human presence, documented avoidance responses by some goats in some situations, but apparent habituation overall. In short, those two do not contribute to the notion that goats are particularly sensitive. Thus, the actual issue is helicopter disturbance, not disturbance *per se*, and that is confirmed by the thrust of various guidelines and position statements that have been generated in response (Denton 2000, Hurley 2004, Gordon et al. 2006, Mountain Goat Management Team 2010).

Helicopter Disturbance Studies

While Foster and Rahe (1981, 1985) get credit for the first systematic observations on this subject, the bellwether study (if I may be permitted a sheep term) is that by Joslin (1986). As the only study linking disturbance to apparent demographic effects, it gave rise to the elevated concern that has followed and no subsequent disturbance-related paper on mountain goats has failed to cite it. Unfortunately, we will never know if the author’s suspicions about population and productivity effects were correct, in part because there was no post-disturbance follow-up to see if things improved, and also because of some apparent

Table 1. Field studies directly addressing disturbance effects on mountain goats.

References	Primary Subject	Focus ^a	Level of Study ^b		
			Short	Medium	Long
Foster and RaHS 1981, 1985	Hydro Exploration	H	✓	t	
Singer and Doherty 1985	Highway & Tourism	N,P	✓	✓ ^c	
Joslin 1986	Seismic Exploration	H	✓	t	✓
Penner 1988	Oil/Gas Exploration	N,P	✓	t	
Cote 1996	Seismic Exploration	H	✓		
Gordon and Reynolds 2000	Goat Surveys	H	✓		
Gordon and Wilson 2004	Helicopter Logging	H	✓	t	
Goldstein 2005	Response to Helicopters	H	✓		

^aFocus - Response to H (Helicopters), N (Noise), P (Human Presence)

^bLevel of Study: Short Term (overt) responses; Medium Term (range abandonment) responses; and Long Term (demographic effects). Under Medium, “t” = temporary effect.

^cNo range abandonment was noted as related to goat use of the Walton Lick.

study design issues as related to controls. The original (283 page) report may be clearer on some of these points, but it appears that the two study areas differed in overall size, in the amount of human access and activities besides the seismic work, the intensity of study (collared animals in one and not the other, and therefore possibly more sensitive to helicopter activity if they were originally captured from helicopters), and in the size and initial productivity of the goat populations in each. Further, there appears to have been no clear measure of the amount, distribution, or timing of seismic activity each sub-population was exposed to, although the total (579 km of seismic lines, requiring over 4000 km of helicopter activity over a 4-year period), was clearly extensive. Even at that, no abandonment of home ranges among the collared animals was detected, and observed displacement was local (using terrain features) and temporary, often only a matter of hours. Finally, it was not possible to completely rule out other factors, particularly disease. Joslin (1986) was up front about those matters, clearly indicating that she was reporting correlation, not cause and effect. To date, no study has actually documented disturbance-related goat population declines or reduced productivity.

The next landmark study of helicopter effects was undertaken at Caw Ridge, Alberta (Côté 1996), systematically (but opportunistically) documenting overt responses of 84 goat groups exposed to helicopter overflights. Among the findings were five cases in which groups split up

while fleeing from the helicopter, prompting the following statement: “The group splinterings I observed suggest that mountain goats may be more sensitive to disturbance than other ungulates and that special care should be taken in the management of this species” While the “may be” portion of that statement is appropriate caveat, that has largely been ignored by those citing the paper, and it appears that Côté (1996) gets the credit for originating the “goats are particularly sensitive” concept.

The three remaining studies (Table 1) have provided more sophisticated and detailed observations on the short term, overt responses of mountain goats to helicopters, including video-assisted observations from inside the disturbing helicopter (Gordon and Reynolds 2000), an impressive collection of ground-based observations (Gordon and Wilson 2004), and the only study in which the monitored helicopter approaches were specified by project design rather than being observed opportunistically (Goldstein et al. 2005). It may be noteworthy that the overt responses of goats in the areas studied by Goldstein et al. (2005) were less extreme (“muted in comparison”) than had been documented in other studies.

Careless Citation of Literature

To briefly summarize the preceding material, the only disturbance effects that have been documented are the short term responses of goats to helicopters. An underlying premise to the

“goats are particularly sensitive” idea is that those responses might lead to more serious longer term effects. While that may be valid as a concern, it is not supported by anything we actually know, although the implication that we do know is common in the applicable literature. Despite their own caveats, as described above, Joslin (1986) and Côté (1996) are regularly cited as support for statements alleging long-term population effects.

A related issue is the tendency toward what I refer to as “speculation strings”. It usually takes the form of a list of potential negative effects followed by citation of multiple references. The reader assumes that the cited papers provide documentation for the stated effects when, in fact, they also say that the effects may (or can) happen, themselves citing still other papers speculating similarly. In one case among the papers I reviewed, the two introductory paragraphs cited 26 references, none of which provided clearly relevant evidence for the effects claimed. The speculation string tendency was so pervasive that the paper by Toweill et al. (2004), which described the potential long-term effects as “postulated”, was particularly refreshing.

Mountain Goat Responses to Helicopters

The general interpretation is that goats are afraid (one source said “terrified”) of helicopters. Except for individual animals that have had specific negative experience with helicopters (e.g., pursuit and capture, or repeated intentional “buzzing”), that is unlikely to be the case. Nevertheless, it is a well-established fact that they do indeed respond to helicopters with something that looks like fear. As described by Foster and RaHS (1981) for “severe” response cases, “Goats generally ran in panic toward dense vegetation or for escape terrain (steep rocky areas) while simultaneously aggregating. If already occupying rocky areas, they hid in rock crevices and under overhangs, behind vegetation or even other goats.” Anyone who has conducted aerial surveys of goats will have seen that “hiding” behaviour. In one case I watched a billy which, having no other nearby option in the burn habitat involved, got down on its belly and shimmied under a low-hanging fallen tree.

Consistent with conclusions in Foster and RaHS (1981, 1985), Gordon and Reynolds (2000)

observed that “Goats exhibited a greater overt disturbance reaction to helicopter presence if overhead shelters such as caves, ledges, or large conifer trees with low-lying boughs were not available...” and “Higher overt disturbance levels were noted when the helicopter was above or level with the relative position of mountain goats on the hillside. Lower overt disturbance responses were noted when the helicopter was below the relative position of goats sighted.”

Mountain Goat Responses to their Habitat

Geist (1978) observed that “...mountain sheep and mountain goats tend to respond to very loud noises by fleeing to the sanctuary of the cliffs. This appears to be an innate response to avalanches and rockfalls.” Or, in a characteristically poetic description by Chadwick (1983) “It is a measure of the frequency of snowslides in spring that goats often cease to pay attention to the cracking and booming on all sides of them. It generally takes an overhead rockfall or avalanche sound aimed their way to produce a startled reaction. The ears go back and the tail up, and they are on their way at a gallop. If they are already on a steep section of cliffs they will seek a protective overhang. Lacking that, they pace and stamp and, as the sound rumbles closer, crouch. And then, when the ground starts to vibrate, they squeeze tightly against the uphill rock as if trying to press themselves into a crack...” Clearly, the observable responses to natural overhead sounds and to helicopters are virtually the same.

Most of the papers that have data on or something to say about natural mortality of mountain goats (Brandborg 1955; Lentfer 1955; Holroyd 1967; Chadwick 1977, 1983; Nichols 1982; Singer and Doherty 1985b; Smith 1986; K.S. White, Alaska Department of Fish and Game, pers. comm.) finger “catastrophic downslope movements of rocks, ice, and snow” (Chadwick 1983) as a regular factor. Chadwick (1983) further notes that “Such evidence as is available...points to avalanches as a major source of mortality and therefore an important selective agent in evolution of mountain goat social characteristics.”

None of the sources reviewed have made a direct connection between the response to slides and response to helicopters, but Whittaker and Knight (1998) came close “...wildlife have

developed situation-specific responses because some combination of learning and genetics have made them successful...genetic and learned components may be intertwined and could have particular relevance for understanding avoidance responses. For example, bighorn sheep and mountain goats withdraw to cliffs in response to sudden, loud noises such as rockfalls...when gunshots invoke a similar response, it suggests a genetic component being reinforced through learning.” It seems evident that an innate reaction to loud noises overhead would have survival value, and that we should not expect goats to refrain from reacting or habituate to them.

Sensitivity to Human Disturbance

So, are goats particularly sensitive to human disturbance? If they are, that is yet to be demonstrated. As outlined above, cases of both attraction and habituation are known and most of our examples of avoidance relate to short-term responses to helicopters. Those responses appear to be ecologically appropriate and possibly of no consequence to the animals, part of the daily routine and soon forgotten. Thus, goats may be particularly resilient rather than sensitive to such disturbances.

I mentioned earlier that a “highly sensitive” label does not accord with my own experience, which includes applicable observations both from the air and the ground over a time span of more than 30 years. During a helicopter survey in July 2010, a group of 30+ goats was encountered in and along the creek at the bottom of a canyon. They were highly agitated at our approach, scattering in several directions, and I decided not to attempt an aerial composition count. A few hours later, I was dropped off about 500 m away and made my way on foot to the canyon edge where I observed the animals for about 1.5 hours. All were within 500 m of where they had been “harassed” during the survey, and most were within 300 m. During the observation period, a few adults foraged briefly and two kids interacted in “play”, but the rest of the animals remained in various positions of repose. In summary, that helicopter encounter, which elicited one of the most extreme overt reactions I have witnessed, did not cause the animals to move a significant distance from the location where they were first seen, and did not

appear to result in an enduring negative effect. The main point here is that one-time exposures to disturbance factors are not likely detrimental, and should probably be considered in separate context from the multiple exposures characteristic of some industrial and recreational activities.

There are other inconsistencies with the notion of high sensitivity, of which a major one is the extent and success of goat transplants and reintroductions. The workshop section in the 1996 NWSGC symposium proceedings (pages 145–211) identifies over 225 transplants, involving over 1600 animals, in 13 states and provinces. One of the best known of the transplant successes is that in Olympic National Park, Washington, where the primary management problem became the difficulty and expense required to either control or eliminate goats in the park. As noted by Houston et al. (1994), “Any management program selected will surely test the stamina and commitment of agency managers.”

Context and Caveats

It may seem that I have gone to a lot of trouble just to question the label “Particularly Sensitive (PS)”, so I need to explain why. One reason, and the simplest, is that it is not demonstrably accurate, and accuracy is what science is about. But more importantly, it complicates rather than supports management. The PS label artificially extends to goats a pseudo species-at-risk status, with all the potential for public misunderstanding, imaginary emergency, bureaucratic reaction, and the political interference that typically goes with it. Most people, including those managing land use, read science reports for information rather than for full understanding, and the thrust of current information is that we dare not do more than tiptoe through goat country. That may ultimately be counterproductive, for as outlined by Taylor and Knight (2003), “Unnecessary restrictions may actually have a negative effect on public support for and compliance with conservation-based regulations.” I understand and generally support the precautionary principle, but also firmly believe that speculation should not be the foundation for management actions. That is, our professional advice should be based more on what we know than on what we fear, and researchers and managers need to be more

forthright on that distinction in reporting results and citing literature.

The likelihood that goats are responding to helicopters as part of their natural programming to loud overhead noises does not bail us out of having to further consider effects, but may help in interpretation. Meanwhile, I strongly encourage more research and monitoring on the medium- and long-term effects of disturbance, particularly for regular, intense industrial activity such as the helicopter logging studied by Gordon and Wilson (2004) and the helicopter-supported recreational activities identified by Denton (2000) and Hurley (2004). If we are going to find population level effects other than those related to provision of public access or direct removal of demonstrably important habitat, it will likely be in such situations. At the functional level, the need for careful, responsive, science-based management of goats and goat habitats is the same whether the species is particularly sensitive or not.

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